

The Effects Of Stress And Melodic Intonation
On Apraxia Of Speech

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Introduction

Recent attempts to facilitate speech production in some aphasic adults through the use of Melodic Intonation Therapy (MIT) have been successful (Albert, Sparks and Helm, 1973; Sparks, Helm and Albert, 1974). Although the technique was designed for use with aphasic clients, patients with apraxia of speech should be good candidates for MIT, in view of the criteria which have been described for determining favorable MIT candidacy (Sparks, Helm and Albert, 1974; Helm, in press). At present, the reasons for the effectiveness of MIT are not well understood, although it has been hypothesized that the non-linguistic processing by the right hemisphere and certain "dormant" language areas in that hemisphere may account for part of the recovery (Albert, Sparks and Helm, 1973). While the technique has involved prosodic aspects such as inflection, rhythm and stress, the relationships between these variables have not been adequately described.

The purpose of this study therefore was to investigate the effects of normal and melodic intonation and the position of primary stress placement in active sentence constructions on error productions of apraxic speakers during a sentence repetition task.

Method

Subjects were ten adults with a history of left hemisphere brain damage and articulatory characteristics consistent with a diagnosis of apraxia of speech (LaPointe and Johns, 1975). Additional selection criteria included: hearing sensitivity within normal limits at 500, 1000 and 2000 Hz (ANSI, 1969); no reported history of visual perceptual impairment or premorbid communication impairment; no speech mechanism anomalies; and no significant auditory comprehension deficits as measured by ten selected items from the Revised Token Test (McNeil, 1973). None of the subjects had previously received Melodic Intonation Therapy.

Stimuli were twenty active declarative sentences of an Article + Subject + Verb + Article + Object construction (e.g. The men rowed the boat; The cook cut the meat). The subjects, verbs, and objects of the sentences were consonant-vowel-consonant monosyllabic words that did not contain phonemes reported to be difficult for apraxic speakers to produce (Shankweiler and

Harris, 1966). The stimuli were divided into two lists of ten sentences and the subjects, verbs, and objects were matched for frequency of occurrence and abstractness on the two lists. Each of the sentences was recorded on videotape as it was produced by a normal adult speaker. Sentences on one list were recorded utilizing melodic intonation, while sentences on a second list were recorded utilizing normal intonation. Each of the sentences was recorded three times: once with primary stress on the subject, once with primary stress on the verb, and once with primary stress on the object. The sixty sentences were presented in randomized order to each of the apraxic subjects. The subjects were required to produce each sentence after it was presented on the videotape. Responses were tape recorded and later analyzed for articulatory errors on the subjects, verbs, and objects of the sentences, according to criteria specified by Deal and Darley (1972). One possible error per word was used for computation. Error scores for primary stress placement and intonation type were tabulated for each apraxic subject.

Results

Means, standard deviations, and ranges of error scores as a function of primary stress placement and intonation type are presented in Table I. A treatment x treatment x subjects analysis of variance was utilized to evaluate the effects of these variables on the error scores of the apraxic subjects. The effect of intonation type was significant. Apraxic speakers, as a group, made significantly more errors when the stimulus sentence was presented using melodic intonation than when the stimulus was presented using normal intonation ($F=45.15$; $df=1/9$; $p<.0001$). No significant interactions were found, and the effect of primary stress placement in the sentence was found to be non-significant.

TABLE I. Means, Standard Deviations And Ranges Of Error Scores As A Function Of Primary Stress Placement And Intonation Type

Position of Primary Stress in Stimulus	Stimulus Intonation Type	Mean Number of Errors	S.D.	Range
Subject	Normal	9.3	4.81	4-21
Verb	Normal	8.6	4.84	1-20
Object	Normal	8.2	3.99	1-15
Subject	Melodic	13.4	2.80	8-17
Verb	Melodic	14.8	4.13	9-22
Object	Melodic	13.7	2.79	8-17

In order to determine the types of errors which occurred when primary stress placement was changed, a subsequent analysis of the data was performed. Error scores were re-tabulated for primary stress placement in the stimulus and position of error in the response, collapsing across intonation type, for each apraxic subject. Means, standard deviations, and ranges of error scores

from this subsequent analysis are presented in Table II. A treatment x treatment x subjects analysis of variance was applied to these data to evaluate the effects of primary stress placement in the stimulus and position of the misarticulated word in the response for the apraxic subjects.

TABLE II. Means, Standard Deviations And Ranges Of Error Scores As A Function Of Primary Stress Placement And Error Position

Position of Primary Stress in Stimulus	Position of Error in Response	Mean Number of Errors	S.D.	Range
Subject	Subject	5.9	2.56	3-11
Subject	Verb	9.8	3.33	5-15
Subject	Object	7.0	2.87	3-13
Verb	Subject	8.9	3.67	4-15
Verb	Verb	8.5	3.44	5-15
Verb	Object	6.1	3.25	2-13
Object	Subject	6.6	2.91	3-11
Object	Verb	9.3	3.33	5-16
Object	Object	5.9	2.96	2-11

The effect of position of error in the response was observed to be significant ($F=4.57$; $df=2/18$; $p<.025$). Post-hoc testing revealed that as a group, apraxic speakers made significantly more production errors on verbs than on subjects or objects. A significant two-way interaction was obtained between position of primary stress in the stimulus and position of error in the response ($F=6.79$; $df=4/36$; $p<.0004$). Post-hoc comparisons revealed that apraxic speakers, as a group, made fewer production errors on words when they received primary stress in the stimulus sentence. The effect of placement of primary stress in the sentence again was not significant.

Discussion

The finding that stimuli which were melodically intoned did not facilitate speech production in the apraxic speakers is not a surprising one. Since each of the stimulus sentences was presented only once and required an immediate repetition, it appears that more volitional effort on the part of the subjects was required to produce the response. While earlier descriptions of the MIT technique (Albert, Sparks and Helm, 1973; Sparks, Helm and Albert, 1974) did not include an introductory level, the most recent description of the technique (Sparks and Holland, 1976) introduced a preliminary level which establishes the process of intoning melody patterns and serves to adapt the patient to a procedure which, at first, may seem strange.

The subsequent analysis of the data which examined position of primary stress placement in the stimulus with respect to position of misarticulated word in the response revealed several interesting findings. Apraxic speakers, as a group, made significantly more production errors on verbs than on subjects or objects. This finding might be explained in terms of the information content of verbs. Glucksberg, Trabasso and Wald (1973) suggested that the verb is the most informative or most propositional component of the sentence. It is conceivable then, that the apraxic speakers in this study made more production errors on verbs because of a difficulty with propositionality. If this explanation is tenable, it lends support to the notion that apraxia of speech in the neurologically impaired adult may be an element of an aphasic symptom complex (Trost and Canter, 1974).

Lending further support to this hypothesis is the finding that apraxic speakers, as a group, made significantly fewer production errors on words when they received primary stress in the stimulus sentence. When the subject in the stimulus sentence received primary stress, the apraxic speakers made fewer production errors on the subject than when the verb or object were stressed, and so forth. This finding is consistent with the report by Goodglass (1973) that production for aphasic subjects is facilitated by primary stress, regardless of the grammatical function of the word tested. According to Goodglass, stress factors neutralize the difference in production of grammatical and lexical items.

The position of primary stress placement in the stimulus sentence was observed to be non-significant in both analyses of variance. This was not surprising, in that as primary stress placement changed from subject to verb to object in the stimulus sentences, the actor-action-agent relationships did not change.

In the initial levels of the MIT program, simultaneous with the melodically intoned stimuli and responses, the clinician and client engage in hand-tapping the rhythm and stress of the utterance. As the MIT program progresses, transition back to speech prosody is facilitated by a technique called sprechgesang (speech song) in which the melodic line is retained from the intoned sentence and the constant pitch of intoned words is replaced by the variable pitch of speech. Continued use of handtapping is assumed to aid the client both in using the sprechgesang technique and in maintaining the rhythm and stress of this transitional method (Sparks and Holland, 1976). This rhythmic stimulation was not used in this investigation and may in fact, play a significant role in facilitating speech production.

Rhythmic stimulation has been used in the treatment of other speech disorders, primarily stuttering. Van Riper (1971, p. 407) stated:

...rhythm...facilitates the timing of motor patterns which are prone to asynchrony...(Rhythm) may drive the central mechanism responsible for programming the sound and syllabic coordinations.

While these remarks were made about the rhythm effect as it related to stuttering, it is conceivable that the rhythm effect might have implications for the clinical application of MIT, particularly as it relates to apraxic speakers. The lesion in apraxic speakers is generally attributable to a site near the anterior speech zone, which includes the foot of the third frontal convolution (Broca's area) and which is responsible for the programming of motor speech.

The rhythmic handtapping involved in MIT might serve to facilitate the timing of motor speech in apraxic speakers and may effect regularity in the central mechanism involved in programming the articulatory movements. Support for this timing hypothesis is offered by Lebrun (1976), who suggested that apraxia of speech is a disorder of the articulatory gesture as well as the temporal organization of that gesture. Another tenable hypothesis is that the rhythmic handtapping involved in MIT may merely serve as a distractor, which removes some of the volitional aspects of the motor speech act in apraxic speakers.

It is necessary to view the findings of this investigation with reference to certain limitations. The production errors of the apraxic speakers in this study, for instance, are not necessarily characteristic of all apraxic speakers, in view of the relatively small sample size. It should also be noted that the task utilized in this investigation required a repetition of stimulus sentences, and that this type of task is not necessarily indicative of the spontaneous verbal expression abilities of apraxic speakers. The encoding mechanisms required to formulate spontaneous verbal expression may be intrinsically different from those mechanisms underlying speech repetition.

In conclusion, the findings of this study suggest that melodic intonation, in the absence of the systematic MIT approach, might not be facilitatory for the motor programming of speech in apraxic speakers. The results also suggest that apraxia of speech, while a disruption in the motor programming of speech, may involve linguistic components as part of a larger aphasic symptom complex.

The degree to which rhythmic handtapping facilitates speech production in apraxic (and aphasic) speakers remains unknown. Further research directed toward studying the effects of rhythmic handtapping alone, and in combination with melodic intonation, might serve to provide information about why this therapeutic technique has been effective with some neurologically impaired adults.

Finally, there is a need for further investigation as to the nature of linguistic components associated with apraxia of speech. If the disorder occurs as part of a greater aphasic symptom complex, additional information about the linguistic components involved and how they relate to the disruption in motor programming of speech would appear to be useful in developing more efficient therapeutic strategies for individuals with this disorder.

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Questions And Answers Following Presentation

Q: How was stress created?

A: The person who presented the stimulus items on the videotape was instructed to practice saying or "melodically intoning" each sentence so as to emphasize the subject or verb or object. Following the videotape recording of the stimulus items, three graduate students viewed the tape to determine whether the stimulus was normally intoned or melodically intoned, and also

which word in the sentence received the most emphasis (stress). There was 100% agreement among the judges with respect to intonation type and stress placement.

Q: Was the stress created in a number of different ways or was it done primarily through intensity or through duration?

A: Using the audio portion of the videotape, I made spectrograms of each stimulus sentence; duration appeared to be the most important cue for primary stress placement.

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